## Contents

Continuous Quantum figuis signification de la continuous Quantum figuis de la continuous de

	Preface			page xi	
	Ackn	owledgments		xiv	
	List	of Symbols		XV	
		Stochastic Schrödinger and Master Equations			
1	Intro	duction to Quantum Physics and Measurement		1	
	1.1	Prologue		1	
	1.2	The Era of the Founders: 1920s–1950s		2	
	1.3	The Era of Bell: 1960–1970s		4	
	1.4	Classic Experiments: 1970–1980s		10	
	1.5	The Quantum Information Era: 1990s-Present		19	
	1.6	Generalized Measurements		21	
	1.7	What You Will Learn in This Book		26	
2	Proje	ective Measurement		30	
	2.1	The Stern–Gerlach Experiment		30	
	2.2	Measurements on Multiple Systems		35	
	2.3	Mathematics of Projective Measurement		37	
	2.4	Continuous Variables		42	
	2.5	Discussion of the Cardinal Properties of Projective			
		Measurement		42	
3	Gene	eralized Measurement		46	
	3.1	Measuring the Polarization of a Single Photon		46	
	3.2	Measuring Polarization with Position		49	
	3.3	Polarization State Update		50	
	3.4	Mathematics of Generalized Measurement		53	
	3.5	von Neumann's Model: An Example with a Qubit and Free			
		Particle Meter		54	

	3.6	Generalization to Mixed States	57
	3.7	Quantum Bayesian Point of View	60
4	Weak	Measurement	64
	4.1	The Limit of a Very Weak Stern–Gerlach Magnet	64
	4.2	Information—Disturbance Trade-off	66
	4.3	Weak Value	71
	4.4	Weak Value Amplification	75
	4.5	Generalized Eigenvalues for Any Measurement Type	81
5	Cont	inuous Measurement: Diffusive Case	90
	5.1	Measuring the Location of an Electron on a Double Quantum	
		Dot with a Quantum Point Contact	91
	5.2	Measuring the State of a Superconducting Quantum Circuit	
		with Electromagnetic Radiation	97
	5.3	Stochastic Schrödinger and Master Equations	104
	5.4	Continuous Measurement	108
	5.5	Stochastic Path Integral	120
	5.6	Diffusive Measurement with Continuous Variables	124
6	Cont	inuous Measurement: Quantum Jump Case	129
	6.1	Blinking Atoms and Their Emitted Photons	130
	6.2	Quantum Jumps in Superconducting Qubits	133
	6.3	Continuous Nature of Quantum Jumps	135
	6.4	Modified Stochastic Quantum Equations of Motion	138
7	Linear Detectors		153
	7.1	Quantum Noise and Measurement Limits	155
	7.2	Linear Response Theory	156
	7.3	Quantum Limited Pointer States	161
8	Quar	ntum Amplification	169
	8.1	Quantum-Noise-Limited Operation	169
	8.2	Superconducting Josephson Tunnel Junction Circuits	171
	8.3	Degenerate Parametric Amplifier	173
	8.4	Standing-Wave Amplifier Circuits	176
	8.5	Traveling-Wave Amplifier Circuits	179
		Foliarization State Update	
9	Meas	surement-Related Phenomena and Applications	186
	9.1	Measurement Reversal	186
	9.2	Most Likely Path	189

	9.3	Joint Measurement of Noncommuting Observables	199
	9.4	Entanglement by Measurement: Direct and Indirect	205
10	Feedback and Control		218
	10.1	General Theory of Feedback	218
	10.2	Continuous Quantum State Analog Stabilization	220
	10.3	Canonical Phase Measurement	223
	10.4	Continuous Error Correction	228
11	Epilogue: What Does It All Mean?		233
	11.1	What Quantum Mechanics Is and Is Not	233
	11.2	Charting the Quantum Technological Frontier	234
	11.3	What We Have Learned and the Road Ahead	235
	11.4	Beyond Quantum	238
App		Review of Classical Probability Theory	239
Appendix B Mixed Quantum States			243
References			249
	Index	mees associated with it. Indeed, in madecades with the introduct with	261